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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Project | Date April 1, 1941 | Author R. C. Hall

TITLE

MEMORANDUM FOR DR. CRAIGHEAD.

RE: PRECIPITATION AND INSECT LOSS IN NORTHEASTERN CALIF.

SUBJECT—

INDEX NO.—

U.S. GOVERNMENT PRINTING OFFICE 8—9743

MEMORANDUM FOR DR. CRAIGHEAD

Re: Precipitation and Insect Loss in Northeastern California.

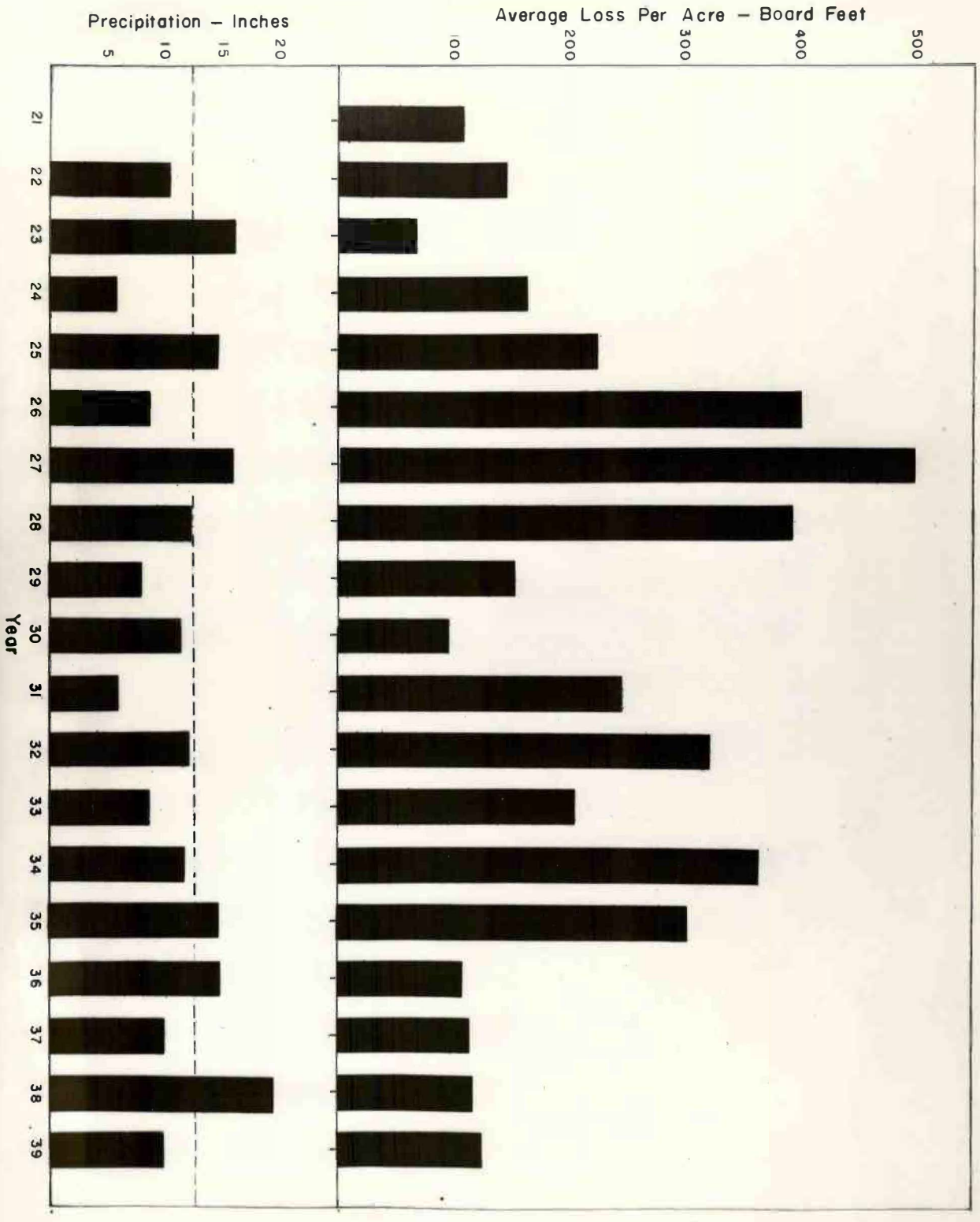
I was quite interested in your letter of February 24 concerning your prediction of the possible effect of our heavy precipitation this season on timber losses next year.

I have given this matter considerable thought and have been trying to work out the correlation between precipitation and timber losses in the Modoc with what meagre weather records that are available. For the purpose I have used the weather records from Lakeview in southeastern Oregon as well as the average for all stations in eastern Oregon. The timber loss records are those from our Modoc survey plots.

We all talk about the effect of precipitation on timber losses as if it were a rather simple thing. Most of us assume that if we have a season of excess precipitation one year that it will be followed by lower timber losses the following season. Or if our precipitation is deficient, that timber losses the next year will be going up. I am very definitely convinced that it is not nearly so simple as that. Of course much of our difficulty in developing the picture that we are convinced is there is probably due to the complete lack of precipitation data right out in the woods where losses are occurring. To meet that definite need was one of the main purposes of our climate project being set up as it was. It will be several years, however, before our weather records out in the woods will yield us much concrete data on this perplexing question.

However, let's look at the picture in light of our present inadequate precipitation data.

Figure 1 illustrates the magnitude of the losses occurring on the Modoc plots since 1921 together with precipitation records, September to September, for the Lakeview weather station. (1924 records would include September 1923 through August 1924.) I think it is quite clear from this that the correlation between precipitation and timber loss is far from clear cut. The years in which high precipitation is correlated with low losses are 1922, 1936 and 1938; the exceptions are 1925, 1927, 1935 or a 50-50 chance proposition (Table I) Note that in 1923 we had 16 inches of precipitation with 66 board feet of loss, but then look at the record for 1927 when with the same amount of precipitation the loss was 495 board feet or about 7½ times the loss for 1923. On the other hand deficient precipitation was not consistently tied in with high losses. In 1924 we had only 5.7 inches or a deficiency of 54 percent, yet the loss that year was only 165 board feet. In 1931 with the same amount of precipitation the loss was 247 board feet.


Precipitation – Inches
5
10
15
20
Average Loss Per Acre – Board Feet
100
200
300
400
500
Year
21
22
23
24
25
26
27
28
29
30
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32
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36
37
38
39

TABLE I

Year	Precipitation*			Average Loss in board feet per acre**
	Actual Inches	Percent Deviation		
		Plus	Minus	
1921				108
1922	10.2		17.7	147
1923	16.0	29.0		66
1924	5.7		54.0	165
1925	14.5	16.9		225
1926	8.6		30.6	402
1927	15.9	28.3		495
1928	11.9		4.0	395
1929	8.0		35.4	151
1930	11.2		9.7	97
1931	5.8		53.2	247
1932	11.9		4.0	321
1933	8.5		47.6	207
1934	11.7		5.6	363
1935	14.6	17.7		300
1936	14.3	15.3		107
1937	9.9		20.1	109
1938	19.3	55.6		109
1939	9.9		20.1	115

* September to September, Lakeview Record.
** From Modoc Survey Plots

Another comparison we could make would be to take the average precipitation for all epidemic years and compare it with the precipitation during the endemic years. Arbitrarily I have chosen losses greater than 200 board feet per acre per year to represent years of epidemics. On that basis we find the following (this incidentally divides the data approximately in half): With nine years of epidemics we find the average precipitation to be 11.5 inches and the average loss 328 board feet per acre. Compare this with the nine years of endemic loss where the average precipitation was 10.5 and the average loss 118 board feet. Here with an average of 1 inch less precipitation we had losses only about 1/3 as great..

I have tried figuring this another way in an attempt to correlate annual precipitation with its effect upon increase or decrease in loss from the preceding year and the year following. Table II presents the data for change in loss for the year in which the precipitation occurred over the loss the preceding year. That is; say the precipitation for 1924 was 5.7 inches and the loss was 165 board feet: this compared with the loss for 1923 shows an increase of 165 percent. In Table III the 1924 precipitation would be compared with the loss for 1925 or an increase of from 165 to 225 - an increase of 36 percent.

Table II

Year	Precipitation, Oct.-Sept. Departure from normal % Minus	Plus	Change in Insect Loss from preceding year. Board feet.	Percent of Change in Loss Plus	Minus
1924	54		Increase from 66 to 165	165	
1931	53		Increase from 97 to 247	154	
1933	48		Decrease from 321 to 207		36
1929	35		Decrease from 395 to 151		62
1926	31		Increase from 225 to 402	78	
1937	20		Increase from 107 to 109	2	
1939	20		Decrease from 150 to 90		40
1922	18		Increase from 108 to 147	36	
1930	10		Decrease from 151 to 97		35
1934	6		Increase from 207 to 363	75	
1932	4		Increase from 247 to 321	30	
1928	4		Decrease from 495 to 395		20
1936		15	Decrease from 300 to 107		64
1925		17	Increase from 165 to 225	36	
1935		18	Decrease from 363 to 300		17
1927		28	Increase from 402 to 495	23	
1923		29	Decrease from 147 to 66		55
1938		56	Increase from 109 to 150	38	

Table III

Year	Precipitation Oct.-Sept. Departure from normal % Minus	Plus	Change in Insect Loss from Preceding Year to Year Following	Percent of Change in Loss Plus	Minus
1924	54		Increase from 165 to 225	36	
1931	53		Increase from 247 to 321	30	
1933	48		Increase from 207 to 363	75	
1929	35		Increase from 97 to 247	154	
1926	31		Decrease from 495 to 395		20
1937	20		Increase from 109 to 150	38	
1939	20				
1922	18		Increase from 66 to 165	165	
1930	10		Increase from 247 to 321	30	
1934	6		Decrease from 300 to 107		64
1932	4		Decrease from 321 to 207		36
1928	4		Decrease from 395 to 151		62
1936		15	Increase from 107 to 109	2	
1925		17	Increase from 225 to 402	78	
1935		18	Decrease from 300 to 107		64
1927		28	Decrease from 495 to 395		20
1923		29	Increase from 66 to 165	165	
1938		56	Decrease from 150 to 90		40

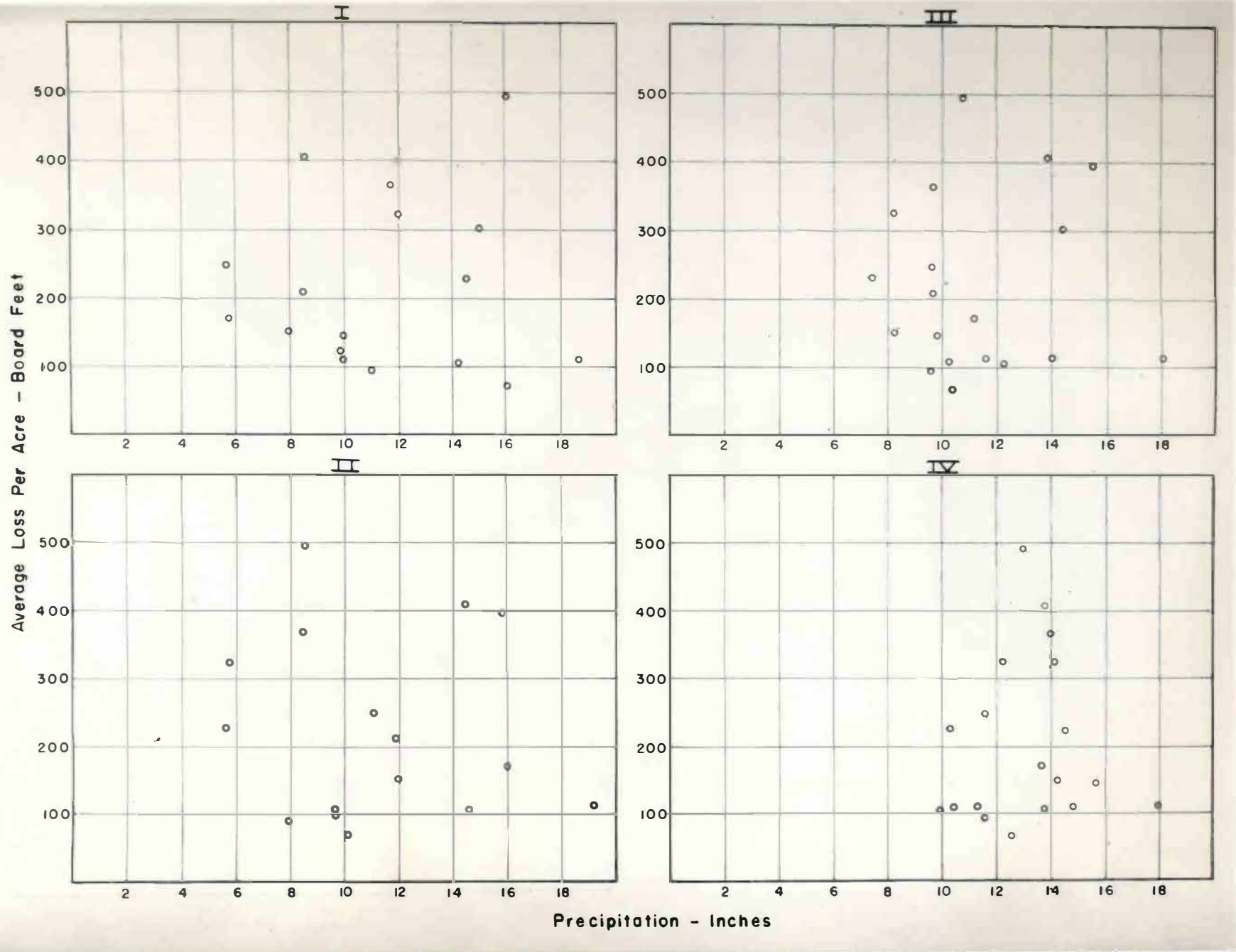
In referring to Table II it may be noted that in 12 years of deficient precipitation seven years showed increasing trends in infestation while five showed declining trends. This could hardly be considered significant. In the six years of excess precipitation three showed increase and three decrease - again no significance. Table III shows practically the same thing with some possibility of a significant relationship during years of very low precipitation, but on this basis the greatest percentage increase in loss coincides with next to the greatest increase in precipitation.

Figure 2 is another attempt to get a picture we expect. Cell No. I shows the precipitation, September to September, for Lakeview plotted against the loss for the same year in the Modoc. Cell II is the same precipitation plotted against the loss the year following. Cell III is the precipitation for the calendar year at Lakeview plotted against the same year of loss, and Cell IV is the average precipitation for eastern Oregon plotted against loss for the same year. There is nothing in any of these figures which suggests a significant trend to me. I have not attempted to treat these statistically by regression equations because I am convinced that there is too much variation in loss in each precipitation interval to make any regression equation significant.

The eastern papers apparently have been featuring our California "Rainy Season" this winter, but our Hat Creek stations are showing only a slight increase over the 1940 records. I believe the total seasonal will probably be in excess of 1940, but not very greatly so. Even in the face of double the precipitation in 1940 over that for 1939, the losses in 1940 in the Hat Creek area are about 50 percent greater than in 1939. Here is just another case where the facts do not fit our theory. I am still sticking with my cycle theory as that seems to me to be the most consistent of anything we have developed so far as a predicting mechanism. In order to be consistent I will have to predict greater losses in 1941 than occurred in 1940, and if the present cycle follows the past two, the peak should occur in 1941. This prediction is made in the face of two years of considerably greater than normal rainfall - 1940 and 1941. I have my fingers crossed on that one, but that is the prediction from the curve.

I would be very much interested in your reaction to the reasoning ussd in the above discussion. I would appreciate any suggestions you might have as to the way these data might be manipulated to show the effect of precipitation on bug losses that we all have been talking about. If it is there, it is pretty elusive as far as I'm concerned.

I am considering giving a paper at Pasadena in late June covering some of the work we are undertaking on our Climate and Loss study in California. Have you any suggestions on the development of the subject for that talk?


I
II
III
IV
500
400
300
200
100
2
4
6
8
10
12
14
16
18
Average Loss Per Acre - Board Feet
Precipitation - Inches

We have considerable additional information in our files on westside conditions near Northfork. I plan to analyze these data in the near future and perhaps we can get a more comforting picture out of that.

Respectfully submitted,

Ralph C. Hall
Associate Entomologist

Berkeley, California
April 1, 1941